

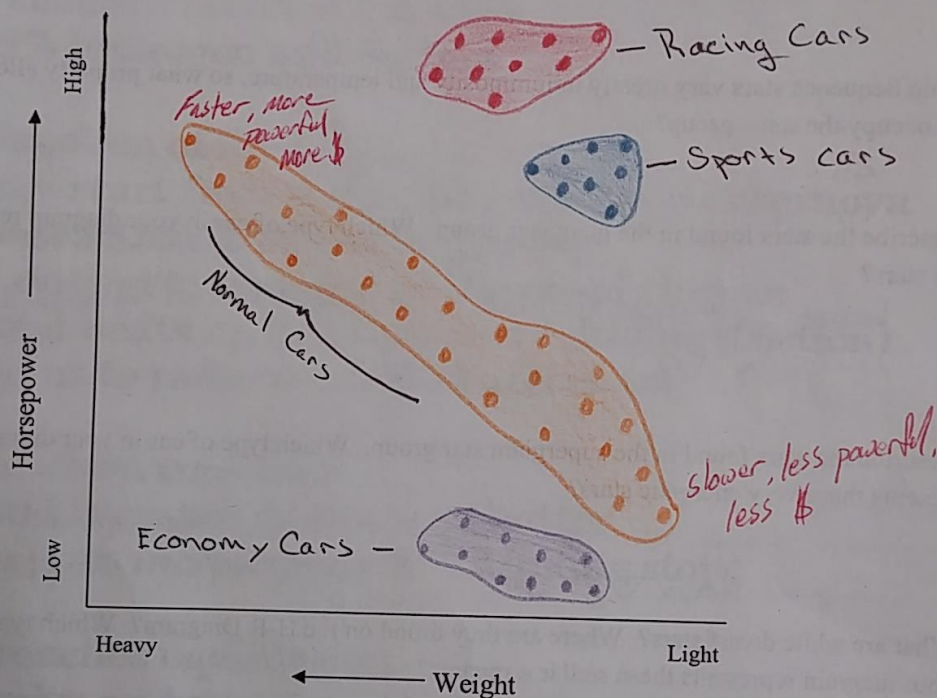
Period: Mp3

Date:

Name: KEY

H-R Diagram Activity

On the graph below, plot using dots (•) these 4 types of cars: **Sports Cars** (coupes, Lambos, Corvettes, Ferraris GT's), **Normal Cars** (Escorts, 4-door sedans, Small to large SUV's, Small to large Pick-ups), **Economy Models** (usually smaller cheaper imports, Ford Focus, Taurus, Honda Civic), and **Racing Cars** (NASCAR, Dragsters, Funny Cars, Indy). Use multiple dots to represent all the variety in each group.



Read about the Hertzsprung-Russell Diagram in the McDougal textbook pgs. 626-627, and answer the questions below.

1. After whom is the H-R Diagram named after?

Named after Ejnar Hertzsprung-Russell (Denmark)
 &
 Henry Norris Russell (USA)

2. Which variables are stars plotted against on the H-R Diagram?

Luminosity & Temperature

3. Define "luminosity".

The brightness of a star.

4. Associate the variables on the H-R Diagram with the variables on your Car Type Diagram. (which variables represent each other?)

Luminosity = Horsepower

Temperature = Weight

5. Most stars in the H-R Diagram are part of what group? What group of cars in your diagram is representative of these stars?

Main Sequence = Normal Cars

6. Main Sequence stars vary greatly in luminosity and temperature, so what property allows them to all occupy the same group?

All stars in the main sequence are actively fusing hydrogen to helium.

7. Describe the stars found in the giant star group. Which type of car in your diagram represents these stars?

Large luminosity, cool temperatures, Diameters $10-100 \times D_{\odot}$ - Sports Cars

8. Describe the stars found in the supergiant star group. Which type of car in your diagram represents these very energetic stars?

Very large luminosities - very hot temperatures, to cool
Diameters $> 100 \times D_{\odot}$ - racing cars

9. What are white dwarf stars? Where are they found on the H-R Diagram? Which type of car in your diagram represents these stellar remnants?

Glowing stellar cores that have lost their outer atmospheres. These were once red giant stars. low luminosity - generally medium temperatures.

10. What types of stars are the following?

Spica - Main Sequence

Proxima Centauri - Main Seq. (red dwarf)

Polaris - Giant

Sirius - Main Sequence

Betelgeuse - Super Giant (red)

Sun - Main Sequence

Rigel - Giant

H-R DIAGRAM STARS

Stellar Evolution Quiz pages 342-348

Word bank for #'s 1-11

red giant stars, supergiant stars, dwarf stars, cepheid variable stars,
eclipsing binary stars, pulsars, nova, supernova, black holes, neutron stars,
nebula

1. Core of an exploded star where the protons and electrons have been crushed together. *neutron stars*
2. Stars that are cooler and brighter than normal stars ex. Aldebaran *RGs*
3. Stars that give off powerful bursts of energy every second. *Pulsar*
4. The core of a star so dense that nothing, not even light can escape it. *Black hole*
5. Great cloud of gas and dust in space. *nebula*
6. Brightest and biggest stars. ex. Betelgeuse *SGs*
7. An explosion of a star. *Supernova*
8. Yellow supergiants whose brightness changes at regular intervals. *CVS*
9. A sudden but temporary flair up of a white dwarf. *Nova*
10. Two stars that pass in front of each other as seen from Earth. ex. Algol *EBS*
11. Hottest and dimmest star type. *dwarf stars*

Word bank for #'s 12- 16

red giant, supergiant stars, white dwarf, protostar, nebula, stable state
pulsars, nova, supernova, black holes, neutron stars,

12. Which stage is the first stage our Sun was in before it was a star? *nebula protostar*
13. Which stage is the Sun in now? *ms stable state*
14. What is the final stage our Sun will be? *white dwarf*
15. What stage will the Sun be after this stage? *red giant*
16. What stage was our Sun following a nebula stage? *protostar*

Arrange these stages in the life history of a star

Birth of a star

- (A) 9 the young star still surrounded by its nebulosity is called a cocoon star
- (B) 5 friction builds as the dust cloud collapses and grows denser
- (C) 7 the temperature reaches 20,000,000 F in the core and hydrogen fusion begins
- (D) 8 a star is born
- (E) 4 the nebula stirs and mixes
- (F) 11 the star is now a main sequence star spending 90 % of its life in this state
- (G) 1 a dust cloud is in the inter-stellar medium
- (H) 2 a shockwave from a distant supernova acts as a catalyst
- (I) 10 a state of equilibrium is reached between the pressure from heat and gravity
- (J) 6 radiating heat and radio waves it is now a protostar
- (K) 3 gravity causes the nebula to begin to collapse

After Main Sequence

- (A) 6 gravitational energy eventually becomes great enough to allow helium in the core to fuse
- (B) 9 surface layers of a red giant expand and contract creating a pulsating star
- (C) 1 helium ash in the core slowly builds up
- (D) 3 the fusion in the core stops
- (E) 8 the star grows and is called a red giant
- (F) 7 He fusion produces carbon and oxygen ash the core contracts and grows hotter
- (G) 5 friction from the collapse causes hydrogen in the outer layers to fuse
- (H) 4 the core collapses under the weight of the outer layer
- (I) 2 usable hydrogen in the core becomes exhausted, the helium ash impedes fusion

Death of a star one solar mass.

- (A) 4 the star is not shining by fusion anymore it shines by incandescence it is a white dwarf
- (B) 3 a hot, carbon core remains
- (C) 6 the sphere is called a black dwarf
- (D) 1 the star slowly ejects its outer layers
- (E) 5 the core eventually burns itself out leaving a dense, cold carbon sphere in space
- (F) 2 a planetary nebula is formed

Death of a star ten solar masses.

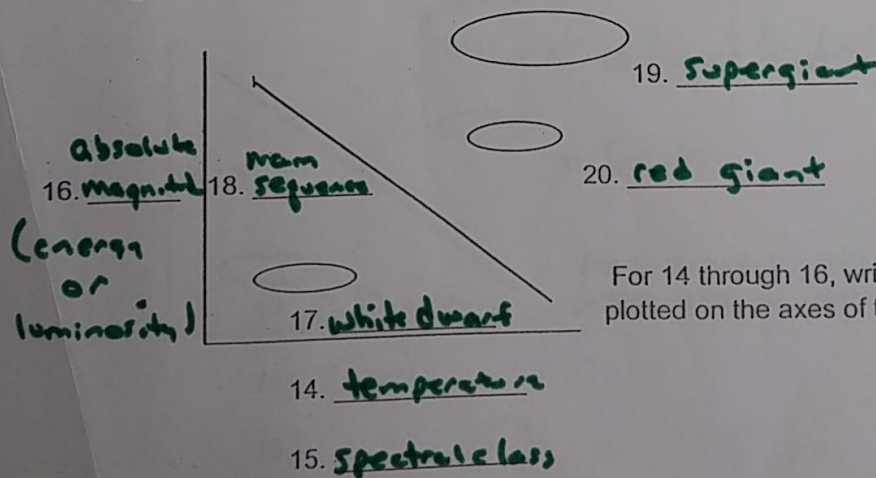
- (A) 6 a collapsed core may remain
- (B) 3 core becomes unstable and collapses
- (C) 2 iron is a by product of fusion and cannot be fused itself
- (D) 4 the result is a supernova explosion
- (E) 5 the core may be crushed into a neutron star or a black hole
- (F) 1 carbon and other elements are fused in the supergiant stage

ESS Vocabulary Quiz (20 pts)

Name Key

1. l evolution a. a cloud of dust and gas in space
2. m variable star b. a balance between pressure and gravity
3. f main sequence c. rapidly spinning source of radio bursts
4. g Kelvin d. H atoms join to form He atoms
5. k supernova e. old very dense star that faintly glows for millions of years
6. h black hole f. diagonal band of stars on the H-R diagram
7. e white dwarf g. temperature scale with absolute zero
8. i red giant h. gravity powerful enough to trap light
9. a nebula i. occurs when a star expands and cools
10. j protostar j. a glowing cloud that will become a star
11. c pulsar k. the violent explosion of a star
12. b equilibrium l. slow continuous change over a long period of time
13. d fusion m. a star whose magnitude continuously changes

HR Diagram--Label the regions of the diagram with the proper name.



For 14 through 16, write the properties plotted on the axes of the graph.

Name _____
Date _____ Pd. _____

Directions: Circle the one member of the group which does not belong and relate why.

- | | | | |
|-----------------------|--------------------|-------------------|------------------|
| 1. main sequence star | <u>blue giant</u> | white dwarf | black dwarf |
| <hr/> | | | |
| 2. Sun's stages | red giant | <u>supergiant</u> | white dwarf |
| <hr/> | | | |
| 3. O | A | K | <u>W</u> |
| <hr/> | | | |
| 4. fusion | hydrogen | <u>protostar</u> | 20,000,000 |
| <hr/> | | | |
| 5. main sequence | <u>Betelgeuse</u> | Sun | G |
| <hr/> | | | |
| 6. hydrogen | fusion | helium | <u>iron</u> |
| <hr/> | | | |
| 7. Sun | <u>supernova</u> | planetary nebula | red giant |
| <hr/> | | | |
| 8. nebula | <u>supernova</u> | ISM | H and He |
| <hr/> | | | |
| 9. black hole | <u>black dwarf</u> | neutron star | supernova |
| <hr/> | | | |
| <u>10. hot</u> | red giant | bright | large |
| <hr/> | | | |
| 11. radio | protostar | <u>pulsar</u> | infrared |
| <hr/> | | | |
| 12.6 mile diameter | spins | pulsar | <u>red giant</u> |
| <hr/> | | | |
| 13. stars temperature | white | <u>black</u> | yellow |
| <hr/> | | | |
| 14. M | longest life | most numerous | <u>red</u> |
| <hr/> | | | |

Name Key Class _____ Date _____

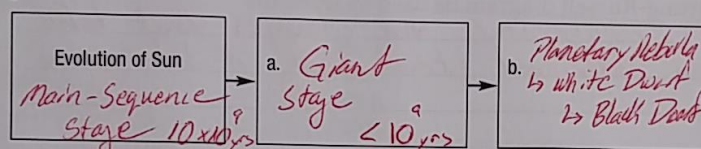
Chapter 25 Beyond Our Solar System

Section 25.2 Stellar Evolution

This section describes the evolution of stars from birth to burnout and death. It also discusses types of stellar remnants.

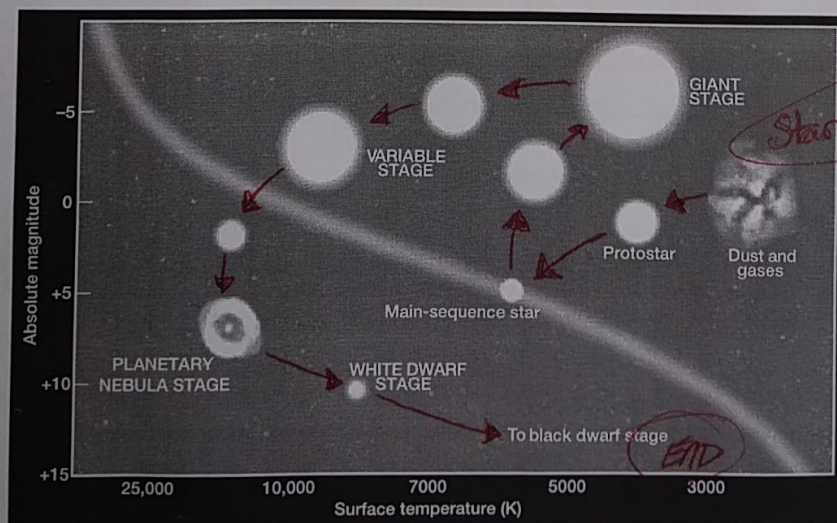
Reading Strategy

As you read, complete the flowchart to show how the sun evolves. Expand the chart to show the evolution of low-mass and high-mass stars. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.



Star Birth

- What is the process by which a star is born? Gravitational contraction of initial nebula until the core of a protostar reaches $\sim 10 \times 10^6$ °K & pressure is great enough for nuclear fusion of Hydrogen.
- List in order the labeled stages shown on the figure that a medium-mass star goes through during its "life." (Hint: it may be helpful to draw arrows on the figure from stage to stage.)
 - Dust and gases (nebula)
 - Protostar
 - Main-Sequence Star
 - Giant Stage
 - Variable Stage
 - Planetary Nebula Stage
 - White Dwarf Stage
 - To black dwarf stage



Name _____ Class _____ Date _____

Chapter 25 Beyond Our Solar System

3. A(n) protostar is a developing star not yet hot enough to engage in nuclear fusion.
4. Is the following sentence true or false? An average star spends 90 percent of its life as a ~~helium~~ hydrogen-burning main-sequence star.
False

Burnout and Death

5. ☒ Is the following sentence true or false? All stars eventually run out of fuel and collapse due to gravity. True
6. How can a Hertzsprung-Russell diagram be used to show the evolution of a star? Illustrates the changes that take place in an individual star during its life span

Match each death description with its star.

Death Description	Star
<u>b</u> 7. forms a red giant, which then collapses into a red dwarf and forms a planetary nebula	a. low-mass star
<u>c</u> 8. blows up in a supernova explosion	b. medium-mass star
<u>a</u> 9. does not form a red giant; collapses directly into a white dwarf	c. massive star

Stellar Remnants

10. ☒ List the stages the sun has gone through and will go through during its evolution. Began as a nebula, spend much of its life as a main-sequence star, then become a red giant, planetary nebula, white dwarf, and finally a black dwarf.
11. A(n) pulsar is a neutron star that rotates and generates radio waves.

Match each description with its stellar remnant.

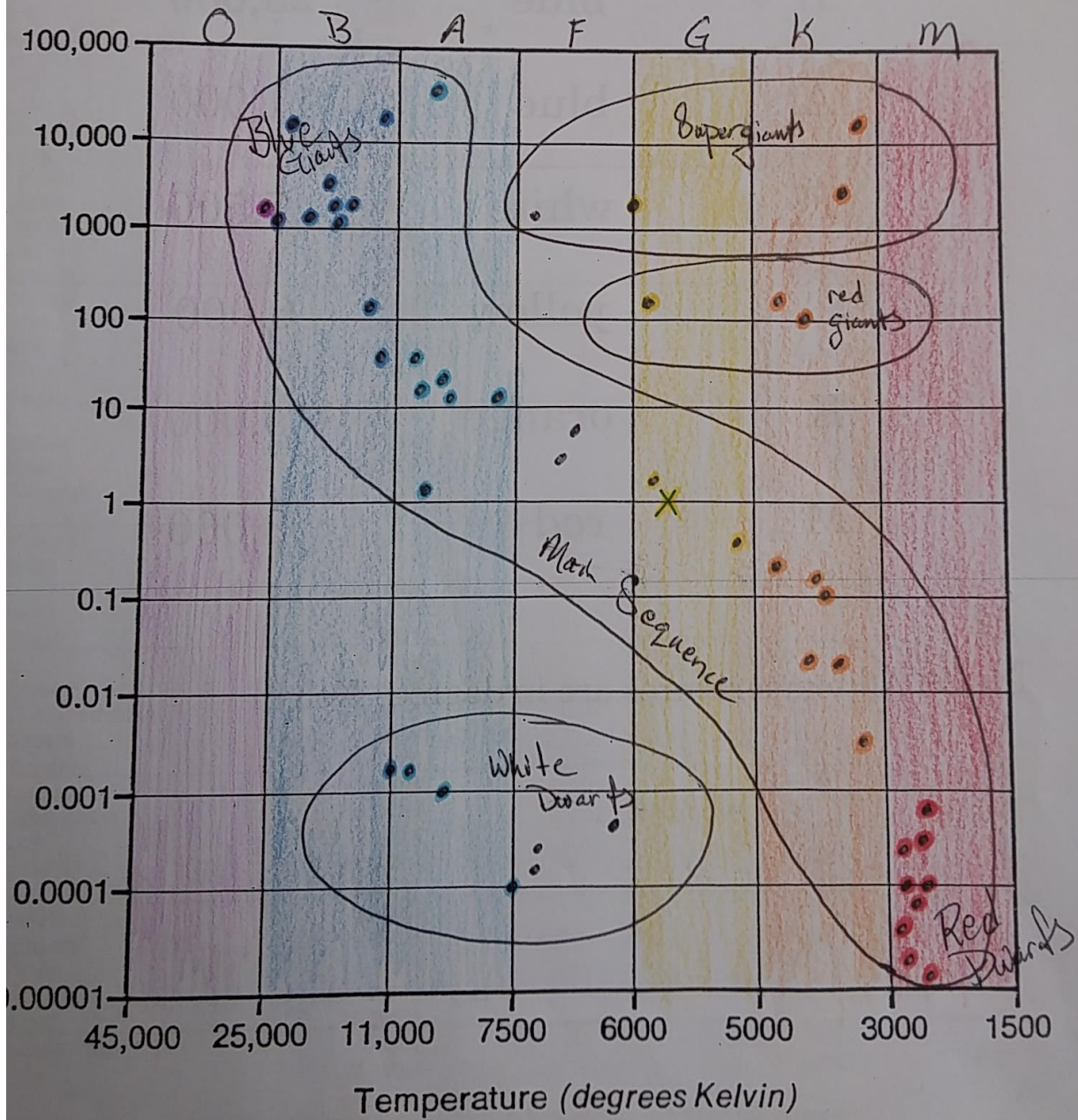
Description	Stellar Remnant
<u>c</u> 12. remnant of a supernova event; similar to a large atomic nucleus	a. black hole
<u>a</u> 13. small dense object formed from the remnants of a star at least three times as massive as the sun	b. white dwarf
<u>b</u> 14. remnant of a low-mass or medium-mass star	c. neutron star

E

DATE

Scatter stars on paper

19)



3. ✓ Circle the stars that have a luminosity of less than .01 and a temperature of greater than 6,000 K. & label them white dwarf stars.
4. ✓ Circle the stars that have luminosities over 100 and a temperature of less than 6,000 K. & label them red giant stars.
5. ✓ Circle the stars that have luminosities over 1,000 & temperatures less than 11,000 K. & label them super giant stars.
6. ✓ Circle all the remaining stars and label them the main sequence.
7. ✓ At the top of the column, label all stars that have a temperature of greater than 25,000 K. with the letter O.
8. ✓ At the top of the column, label all stars that have a temperature of greater than 11,000 K. and less than 25,000 K. with the letter B.
9. ✓ At the top of the column, label all stars that have a temperature of greater than 7,500 K. and less than 11,000 K. with the letter A.
10. ✓ At the top of the column, label all stars that have a temperature of greater than 6,000 K. and less than 7,500 K. with the letter F.
11. ✓ At the top of the column, label all stars that have a temperature of greater than 5,000 K. and less than 6,000 K. with the letter G.
12. ✓ At the top of the column, label all stars that have a temperature of greater than 3,000 K. and less than 5,000 K. with the letter K.
13. ✓ At the top of the column, label all stars that have a temperature of greater than 1,500 K. and less than 3,000 K. with the letter M.
14. ✓ Color the M class stars red, the K class stars orange, the G class stars yellow, the F class stars leave as white, the A class stars light blue, the B class stars medium blue, the O class stars as a light purple.

What determines the color and spectral class of a star? (size, temperature, brightness, age)

White dwarf stars are (hot, cool) & (dim, bright) compared to other stars of the same class.

Red giant stars are (hot, cool) & (dim, bright) compared to other stars of the same class.

What type of star is our sun? (MS, SG, RG, WD) What classification letter is our Sun? G

As main sequence stars get hotter they also get (dimmer, brighter).

As stars get higher on the H-R diagram they also get (larger, smaller)

*** READ PAGES 342 - 348 TO ANSWER THE REMAINING QUESTIONS *** → 25.2 in Pearson

Which type of star on the H-R diagram is closest to the end of its life? (MS, RG, SG, WD)

Which type of star on the H-R diagram is considered to be in a stable state? (MS, RG, WD)

Which type of star on the H-R diagram is the next stage for our Sun. (MS, RG, SG, WD)

What type of star produces a nova? (MS, RG, SG, WD) a supernova? (MS, RG, SG, WD)

Which spectral class lives the longest life? (O, B, A, F, G, K, M) the shortest? (O, B, A, F, G, K, M)

✓ Label where blue giant stars would be on the diagram. Label where red dwarfs would be.

What characteristic determines where a star will fall on the main-sequence? Luminosity & temp.

What characteristic must an object have to be classified as a star? nuclear fusion → balance between gravity & pressure

What type of stars may eventually turn into neutron stars and black holes? Super giants → the largest/hottest

Why are main - sequence stars the most numerous?

Stars spend the most time on MS, universe is relatively young

PARALLAX

- KEY -

Read topic # 9 page 417 plus the lab introduction before answering these questions.

While keeping your left eye closed, hold the index finger of your right hand in front of you at arms length and cover the chalk line on the board. Without moving your head or finger open your left eye and close your right eye. Note the apparent shift of your finger when compared to the chalk line. Now repeat the demonstration, except this time hold your finger only two inches away from your right eye. Answer the following questions.

1. How did the apparent shift of your finger change when your hand was moved to a distance of two inches as opposed to an arms length away?
Apparent Shift was larger at two inches.
2. Compare your finger demonstration to figure 3.1 What in your demonstration compares to the Earth at position one?
Right eye
3. What compares to the Earth at position two?
Left eye
4. What do the nearby stars represent?
Finger
5. What in figure 3.1 represents the chalk line?
Distant stars
6. The distance between Earth at positions 1 & 2 is called the baseline. Would a bigger baseline produce a larger or smaller shift?
Larger Shift
7. Why do stars show a parallax shift as seen from Earth?
Because the earth revolves around the Sun.
8. What does parallax determine about a star?
Distance
9. What does parallax prove about the Earth?
It is moving in space, not still as in geocentric model.
10. Stars that are closer to the Earth have a parallax shift that is (larger , smaller , the same) than stars that are further away.
Larger
11. Why is parallax measured at six month intervals?
To achieve greatest shift a star could have - largest baseline.
12. What does the term stellar parallax mean?
Apparent change in a stars position observed when sighted from opposite sides of Earth's orbit.
13. What is the definition of the term parallax angle?
1/2 of a star's total apparent Δ (1/2 stellar parallax)
14. In what unit is stellar parallax measured?
arc seconds
15. How much of a degree is one second of arc?
1/3600 of 1°
16. Is one second of arc a large unit or a small unit?
very small unit
17. How far away must a star be to shift one second of arc?
1 parsec or 19 trillion mi
18. What is the origin of the term parsec?
The distance to a star if its parallax was 1 second of arc.

19. How many miles is one parsec ?
19 trillion miles
20. How many light years is one parsec ?
3.26 ly
21. How many miles in one light year (round to the nearest trillion) ?
6 trillion miles
22. Stars that are over one parsec away would have a parallax shift that is (greater than , less than , or equal to) one second of arc
less than
23. What is the greatest distance stars can be accurately measured for a parallax shift ?
20 parsecs
24. Why is there a limit to the parallax measurement ?
Atmospheric blurring, and % error becomes too large for
25. What is the formula to convert a parallax shift into a distance ? *very small parallaxes*

$$d(pc) = \frac{1}{p(")}$$